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ABSTRACT

This paper reports a series of studies of environmental cognition. Conducted among American preschoolers, Navajo and Puerto Rican school children, and American, Mexican and Maori adults, all of the studies employ techniques of environmental modelling that permit objects such as buildings, trees and vehicles. A pilot test of the environmental modelling technique conducted in Puerto Rico in 1968 demonstrated that increasingly with age, children grouped the models in ways resembling landscapes. Subsequent studies indicated (1) positive features of the technique in assessing environmental cognition and (2) considerable ability among very young children. Among the Navajo the models were found to be very effective in eliciting talk about Navajo residence patterns. Environmental modelling was used in 1972 to assess environmental cognition among adults in Santa Monica, CA, and, later, to assess the relation of sex roles and socioeconomic class to environmental knowledge among Mexican adults. In 1978, the modelling technique was used to solve a problem of environmental design when the Maori of Waahi, New Zealand, were awarded money to relocate and redesign important areas and structures in their community. Through the use of modelling techniques in planning seminars attended by community participants, planners and other environmental professionals, spatial attributes of Maori cultural organization became evident. (Author/RH)

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CROSS-CULTURAL ENVIRONMENTAL MODELLING

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Toys are everywhere. Some, which we call dolls, are models of humans and anthropomorphized animals; others are environmental models, representations of the fixed and moving shells with which we surround ourselves, the places we live, the tools we use to build and to destroy. Others, still, are not models at all, in any iconic sense: They have an existence all their own.

"Toy" is a label for something "played with" by children; adults "build models" or "collect miniatures" in their "leisure time." Adult "toy shops" are fashionable stores in such places as Beverly Hills, California, selling yachts, sports cars, and the like. To whatever extent there is an American Culture it seems characterized by an excessive consciousness of "childishness" on the part of adults, and a consequent distancing from everything child-like. Adults do not "play," they "use their leisure constructively"--and competitively, in the same way that vocations are pursued.

This paper is an examination of one class of toys--those which can or do model the environment--used by both children and adults, in various parts of the world. It summarizes some ten years of work, part of it published elsewhere. Even so, it is more of a revival than a discovery, a revival of interest in how the developing child and developed adult use "toys" to learn the nature of the large (geographical scale) environments which surround them and can use this knowledge to represent such environments at perceivable

size. In the 1930's, some psychologists were interested in such issues, in the use of environmental modelling to study the development of environmental cognition in children. But they were roundly condemned by their psychoanalytically-oriented colleagues for concentrating on the"unimportant"manifest content of toyplay and ignoring the"really significant"issues, which, so it turned out by coincidence, were those with which psychoanalytic theory was most concerned: oedipal resolutions were clearly more important than geographical resolutions, or so the reasoning went. Environmental modelling disappeared, therefore, from scientific psychology; doll play became the sole "legitimate" technique using toys,and interpersonal conflict the major datum of interest.

During those remarkably innovative and now long-gone days of the 1960's it became clear to some people that the realm of psychology was very much larger than what psychologists studied, that the rules of legitimacy had narrowed rather than broadened domains of acceptable research. Notions of "imagery," "representation," and, later, "cognition," began to return, some through the back doors and some through the side. Psychologists had to acknowledge their influence upon spatial arts and sciences--architecture, planning, geography, etc.--and some interdisciplinary collaboration ensued.

One of these collaborative efforts resulted when several geographers and psychologists at Clark University set out to determine whether it was possible to teach children map-reading at school-entering age by first teaching them to read aerial photographs. The project failed in this quest because nearly all the children tested could not be taught to read aerial photos--they already know. Somehow, prior to the commencement of former education, they had secured a skill which was supposedly relegated to a much later stage of development. Further testing with children from urban middle-class, urban

lower-class, coastal plantation, and mountain peasant backgrounds in Puerto Rico revealed that these environments did not produce strong differences in this ability. These tests indicated, moreover, that the ability to interpret aerial photos at an early age was general rather than particular: children did as well with photos of markedly different environments as with photos of their home areas. Finally, longitudinal testing revealed that, while photo-interpretation ability was already well-developed in kindergarten, there was some improvement over the first four grades, but that this apparently leveled off between grades IV and VI, as shown in Figure 1. Thus, it seemed that at the age that geographical educators said that children were ready to begin learning a certain skill, they had completed such learning!

INSERT FIGURE 1 ABOUT HERE

These results led the Clark University group to question certain realms of educational orthodoxy. One such realm concerns the nature of children's drawings, and why they represent things in the strange ways they do. Children draw spontaneously, and, fortunately for us, some of their favorite subjects are maps. Figure 2 shows four maps spontaneously drawn of the same area by a single 7-year-old child over a two-week period.* The child was interviewed at length concerning what he chose to depict, and why, and how. The taped record indicates certain rather interesting things concerning the nature of his representations.

INSERT FIGURE 2 ABOUT HERE

First, it is clear that the child is not trying to make an icononic match between his "map" and the aerial photograph. Rather, he appears to devise

*Map 1 is missing; hence, only maps 2-5 are shown.

a conventionalized symbol system; thus, our label "failure to coordinate perspectives" merely exposes our own ignorance of what is actually going on. Houses are shown in elevation on a plan view of the world, for example, not because the child is ignorant of the way in which houses ought to be depicted when viewed from above, but because their roof-tops convey so little information. The plan view, quite simply, says much more about what the building is, and does. And the same, of course, holds for motor vehicles.

Secondly, the child does not seem to be striving for absolute consistency among successive representations. "You know, I can't always draw maps the same," the tape reveals. Yet, while the child also recognizes that "there is only one correct map," he is fully cognizant, at age 7, that maps drawn from memory must differ because things are remembered at certain times and forgotten at others, and that different motivational states impel different representations. Thus, a map drawn as night approaches (map 3) becomes a nocturnal image.

Among studies of children's map drawing, the work of Klett and Alpaugh (1976) is outstanding in its detailed examination of the productions of first, third, and fourth-graders.

Environmental Modelling in the World of Children

Seven-year-olds draw rather nice maps, but kindergarten children often have a rather difficult time: their motor skills are insufficiently developed. Even younger pre-schoolers may experience problems with aerial photo identification, not because they cannot read the photos, but because they lack the vocabulary to provide appropriate verbal responses. Our search for a non-verbal test of environmental cognition led us into the "town kits" being produced by educational toy manufacturers in the late 1960's. These kits

contained small, highly schematic and non-detailed models of houses, larger buildings, trees, cars, trucks, trains, etc.--admirably suited to our purposes.

The "environmental modelling" technique received a pilot test in San Juan, Puerto Rico, in Autumn, 1968. Small children were given a sheet of butcher paper and asked, quite simply, to "play with the toys on the paper." A few children grouped the objects by similarity of color and form: all houses together, all cars of the same color together, etc.; and arranged them all in straight rows, followed the edges of the paper. Others (and the proportion increased with age) grouped houses, cars and trees in such a way that, when viewed from above, their constructions resembled a landscape.

It seemed, then, that "toy play" utilizing these small models could provide an index of large-scale environmental cognition for the barely verbal child. We presented a similar task to several classes of Massachusetts pre-schoolers, aged 3 to 5, in 1970. Their toy kits included many of the items mentioned above and streets made of card stock, and their progress was monitored in 3-second time-lapse motion picture photography. For want of sufficient funds, only the final products were analyzed.

Three tests were applied. Two were non-verbal: (1) assessments, by independent panels of judges, of the goodness of approximation of the child's model landscape to a possible real-world landscape; (2) solution of a path-finding problem involving getting from one house to another on the child's own model, by environmentally realistic means, where the two houses would not ordinarily have been intervisible, in full scale, on the ground. A third test clearly involved verbal response, as, in asking the child "What have you made?", it called for a word or group of words descriptive of the whole. In this third test, called the "verbal gestalt," such responses as "city," "town," "village," etc., were scored higher than mere collections of plural nouns such as "houses and cars."

INSERT FIGURE 3 ABOUT HERE

The results are shown in Figure 3. First, when data are "normalized" (expressed as a numerical proportion of performance at the presumed highest developmental level), the verbal measure is clearly far below non-verbal measures at ages 3 and 4. This suggests that traditional approaches to the assessment of environmental cognition, relying upon verbal responses from the child, are insensitive to the child's actual level of cognition, and hence likely to produce low estimates (Fishbein, in press). Second, while there is clearly some improvement in environmental cognition, as indexed by toy play, between ages 3 and 5, the child's abilities evidence considerable development even at the earliest age tested. Other researchers (notably Acredolo, 1976) have carried this further, to deal with even younger children.

The next development in research on children involved collaboration with a group of colleagues at U.C.L.A. on a study of Navajo house forms and settlement patterns. We were interested in the effects of urbanization (which, in the Navajo Nation, often involves change from living in dispersed "outfits" of 15 or 20 people to established settlements of a thousand or so) upon various social, psychological, and cultural characteristics. It was, in this sense, a study of the effects of architectural and urban design changes upon behavior--and children's behavior was a variable of interest.

Millard Madsen et al (1975, 1977) have produced an impressive set of results using a number of "competition-cooperation" games, suggesting that the differences between rural and urban children within a culture are always greater than the differences among cultures, and always in the direction of greater urban competitiveness, even (as in the case of Madsen's games) where such competitiveness is counter-productive. We wanted to apply one of his tests to Navajo children who were entering school for the first time, to whom

the on-reservation urban area containing the school was a totally new environment. At the same time, we wanted to see how, and how well, children understood the rural environments from which they had come. To accomplish the latter, we developed a simplified toy kit which contained models of the three building types most commonly found in rural areas of the Navajo Nation: traditional hogans, houses (hip-roofed rectangular structures), and mobile homes ("trailers").

Pilot testing was done in the Window Rock Public School, Ft. Defiance, Arizona, early in 1975. Each child was tested individually, at a table, with his or her bilingual teacher present. At one side of the table were three bags containing the three rural building types. A sheet of butcher paper was placed in front of the child, who was then shown examples of the three building models, told what they represented, and asked to give their names. He or she was then asked which of the building types he/she occupied at home, given the appropriate model, requested to imagine that the butcher paper represented the child's rural home area, and to place his house in its appropriate location. The child was next asked which of the other building types were also present in the rural homestead, and to locate them appropriately, and so on.

This began as an exercise in environmental cognition, but it was only when the children were presented one additional question about their completed models that the true value of environmental modelling for cultural assessment became manifest. For each of the buildings in his/her model the child was asked repeatedly: "Who lives there?"

These Navajo children had comparatively little working knowledge of English, which compounded the understandable shyness they experienced upon being confronted with an Anglo adult. Thus, they would not talk to the

researcher, but they did talk to the toys. The children displayed very little reticence about using their models to describe the spatial arrangement of people in their home communities. They talked about which family members (including themselves) occupied which structures at what point in time, contributing information not just on settlement form, but on social structure as well: the building models were non-threatening objects, to which they could easily relate. Through the children's relationship to the toys, then, we learned something new about the fluidity of the traditional Navajo extended family homestead.

Environmental Modelling in the World of Adults

A technique for eliciting knowledge and preferences about physical fabrics of urban areas was developed by Lynch (1960) and involved freely-drawn maps executed from memory. Because of its inherent appeal and relative ease of administration, it has probably generated more research than any other technique in environmental cognition developed over the past 20 years, in spite of its critics (e.g. Wood, 1976).

One drawback of the use of freely-drawn maps in cross-cultural application is that the act of drawing with pencil on paper is much more familiar to middle-class westerners than to people of other classes in less technologically developed societies. Rural folk in particular are often further intimidated by being asked to perform by urban people, who, they assume, will evaluate what they produce as being, by urban standards, "wrong."

In confronting this problem in 1972, several of us simultaneously thought of environmental modelling as an alternative route to the assessment of adult environmental cognition. We approached this with some degree of trepidation. Environmental modelling had been developed for use with children, and adults like to believe that they have "put away their childish

things." We decided to conduct our initial experiments with middle-class adult residents in Santa Monica, California, using models of specific buildings in the community and an outline map of the area as a base. The results were sufficiently encouraging to cause us to apply this variant of environmental modelling to assessing the relation of sex roles and socio-economic class to environmental knowledge. We chose Tecate, Baja California, Mexico as our location in 1973, for the following reasons: (1) we had done previous work in the community; (2) it was easily accessible to Los Angeles; (3) sex roles were even more strongly differentiated in Mexican society than in the U.S.A.; and (4) socio-economic classes were less geographically segregated than in many cities of the United States.

Locational accuracy in the placement of models on an outline map was assessed for male and female residents of four areas of Tecate. Results for the two most economically extreme areas are shown in Figure 4. Residents of Primera Sección range from middle- to upper-middle-class, while residents of Colonia Juarez occupy the lowest rungs of the income ladder.

INSERT FIGURE 4 ABOUT HERE

The results show only a small difference in urban knowledge between the two areas for the male residents, but enormous differences for the females. Several explanations suggest themselves. In Colonia Juarez, men journey outward to look for jobs, to work, and to socialize, walking or using public transportation. Women remain at home. Residents of Primera Sección have cars and servants: both men and women, therefore, journey outward from home. Another explanation for the apparent low level of environmental knowledge among lower-class females, suggested by Appleyard's recent book about the planning of Ciudad Guayana, Venezuela, is that traditional women

in Venezuela regard having too much geographical knowledge as somehow "unfeminine." If what is true for Venezuela holds also for Mexico, the more traditional women of Colonia Juarez may have been concealing information they actually possessed.

One of the heartening findings of the Tecate study was the positive enthusiasm shown by the respondents. The woman conducting the research became known as the "Toy Lady" and was frequently invited for coffee. Of the nearly 150 respondents selected for study, only four refused, and those because personal circumstances made it impossible for them to participate.

In mid-1978, an opportunity was presented to apply the technique which had proved so successful in Tecate to an actual problem in environmental design. The Maori community of Waahi, on the North Island of New Zealand, had been engaged in a protracted dispute with the New Zealand Electricity Department involving the construction of an enormous coal-fired power plant overlooking the Marae, or meeting ground. In June, 1978, the Maoris won their fight and were promised nearly a half-million dollars to redesign and elevate the Marae ground, develop new housing, construct a new dining hall, move the Queen's residence, etc.

What subsequently became known as the "Waahi Project," (Stea 1979) involved the planning and re-design of the entire Marae and its surrounds: elevation or possible relocation of the Queen's House and other structures; and the design of new housing, a new dining hall, and pensioner flats. The contributions of a number of institutions were directly or indirectly incorporated: the New Zealand Electricity Department, which had promised to contribute funds; the University of Waikato, through the participation of the Centre for Maori Studies and Research, the Department of Psychology, and the 1978 Conference on Environmental Perception; the Waikato Technical

Institute, which contributed television equipment and technicians; and the Department of Architecture at the University of Auckland, some of whose students and staff cooperated in coordinating an architectural design seminar during the final meeting at Waahi Pa. Robert Mahuta, a member of the Waahi Community and Director of the Maori Centre at Waikato, and Vince Hill and Linda Caplin, two psychology students and Waikato were, along with this writer, the "principal investigators" and major chroniclers of what transpired.

The first seminar, involving physical planning of the Waahi Marae area, used outline maps of the site and small models, to approximate scale, of houses, pensioner flats, and Miria Te Kakara, the dining hall. Using maps and aerial photographs, the planning problem was explained to Waahi community members who attended the seminar, held in the school house. Working in groups, the participants affixed models to the outline maps, after considerable discussion, and proposed new road locations using felt-tipped pens. After all these somewhat unorthodox (but clear and graphic) plans had been completed, each group presented its solution to the problem and answered questions posed by members of the other groups. The identical exercise was repeated shortly thereafter with planners and other environmental professionals attending the Environmental Perception Conference. The products of Waahi Maori and Pakeha professionals were then compared.

The entire process was recorded by audio and videotape throughout, as well as in photographic transparencies and field notes recorded by at least two researchers. The results are currently being distilled: the tapes have been edited into a version which can be distributed among other interested Marae, and more detailed information, concerning both process and product, is being extracted from the field notes.

The results of the seminar were useful in at least three respects:

(1) data was obtained concerning what the Waahi Community perceived as the appropriate spatial organization of the Marae area and its component buildings; (2) a comparison between the perceptions of residents and of professional planners could be attempted; and (3) a useful set of planning/design communication exercises had been devised.

The "planning communication" groups involved in the first Waahi seminar produced a total of eight suggested plans. That even traditional cultural concepts display great variability was indicated by the diversity of products. Some Marae designs were compact, others open; housing was shown as clustered by some, and as open by others. Physical problems were clearly recognized, and reflected in a concern for movement and stasis during inclement weather. Nearly all were concerned with the comfort of people being welcomed onto the Marae, and several suggested a covered walkway between the meeting house and dining hall, now separated by considerable distance. Human and cultural issues were reflected in concerns for specific people, particularly Te Ata, the Queen.

In six of the site plans prepared by the Waahi Community participants in seminar I, all the houses and flats faced the Marae area and encircled it, and all were also situated close to the Queen's residence. Participants in the seminar repeatedly indicated that the houses should be part of the Marae and not separated from each other or from the Marae by either fences or shrubbery.

The pensioner flats in these six site plans were placed in close proximity to Taane. In social and cultural terms it would appear that this closeness to Taane (meeting house) allows the Kaumatua (elders) to be near the place of central activity on the Marae and also close to Taane, representing their traditional ancestral heritage.

INSERT FIGURE 5 ABOUT HERE

Four of the plans show the proposed siting of the Queen's residence close to that of her son (Tuhei), probably a spatial expression of the strong kinship ties that characterize the Maori people. Placing of the proposed new houses around the Queen may also suggest a desire for close community living maintaining (and even strengthening) the relationship between Queen Te Atairangikaahu and her people.

In Seminar II, at the Environmental Perception Conference, Pakeha academics and planners prepared site plan proposals for Waahi Marae, using the same environmental modelling toys as did the Waahi Community. In three Pakeha site plans, the proposed new houses were positioned in small subdivisions away from the Marae area, reflecting typically Pakeha physical planning. Proposed access roads to the new houses were included in five plans, again showing the Pakeha tendency to situate houses along roads or pathways. Only one Maori participant in Seminar II was concerned with relating roads to any of the houses on the Marae.

The professionals involved in the environmental perception conference were considerate of the physical issues involved; their divergence from the Waahi Community in the plans they produced, however, reflected an incomplete understanding of the spatial attributes of Maori cultural organization. Waahi people referred to the meeting house as "Taane" and the dining hall as "Miria," and even a meter change in location of either of these buildings was a matter for serious discussion. The "peopleness" of these ceremonially important buildings was recognized in these ways by the Maori--but not by the Pakeha planners. Planners tended to place the two pensioner flats close to the store; Maoris placed them close to the meeting house. Pensioners will have a grandchild or two living with them, argued the Waahi residents, who can

do whatever shopping is required; but they must be near the Marae so as to "keep it warm", to more easily attend to their duties as representatives of the tangata whenua in preparing for the welcoming, feeding, and housing of guests. Many Maori participants desired to see Te Ata's house moved to higher ground, to avoid flood hazard, and effected this change in such a way as to shorten the already small separation (by Pakeha standards) between the Queen's house and that of her son. Small separations apparently do matter in Waahi, but Pakeha professionals, understandably, failed to perceive this.

A third seminar, involving the design of house interiors and of the dining hall, was held in Taane, the meeting house. This seminar employed a variety of design communication "kits" developed at the University of Auckland and the University of Waikato. These ranged from quite abstract models, such as paper circles indicating only household functions and used in combination to show the relationship among functions, to modular design kits containing much more "realistic" elements at approximate scale. The Waahi residents worked with the former during the morning of this third seminar, then with the "scale" kits, derived at the University of Waikato, in the afternoon. These kits had been assembled based upon cost-of-construction estimates which dictated a maximum 1,200 square foot interior floor area for each house. Three facilities ostensibly devised for automobiles were also included in the kits: a garage, car port, and pad. In reality, these were recognitions of hospitality needs, places which could accommodate rented caravans (trailers) for temporary guests as well as motor vehicle storage and repair.

In Seminar III, the residents and design professionals participated together. Having assembled their kits of "house parts" in the early afternoon, the Waahi residents proceeded to describe their designs most eloquently, designs which tended not to resemble very closely the housing currently

provided by the government or by private contractors. The architects had, in fact, been quite sensitive to at least some cultural needs in their housing design, but were less successful with the dining hall, discussed (and, to some extent, debated) later in the day. A dining hall is not just a dining hall; the multiplicity of functions it performs becomes clear in such design exercises as this.

INSERT FIGURE 6 ABOUT HERE

Certain similarities were evident in the Maori models of household space:

(1) a large living area is seen as very important, for family gatherings and provision of hospitality to visitors;

(2) the kitchen is integrated with, rather than isolated from, the living area, so that those working in the kitchen space can still communicate freely with those in adjacent areas of the house;

(3) the bedrooms are small and located away from the living area;

(4) extra toilet facilities are situated in the garage for visitors and large hui (when caravans or trailers may be rented and temporarily attached to the house);

(5) an extended verandah area, where some guests can sleep during large gatherings in warm weather, was provided by several participants.

(6) many of the plans direct house entrances toward the Marae.

Design of the new Miria prompted much discussion, especially about the proposed location of toilet facilities. The Pakeha architect hired to redesign Miria explained that the toilets located near the kitchen were separated by three doors from other areas, which is more than required by Health Department

Regulations. Community participants, however, felt that other, cultural, factors were more important. Highly unacceptable in Maori tradition is the preparation of food anywhere near toilet facilities. They seemed to want actual removal of the toilet from the dining hall. It was apparent here that Pakeha lack of understanding for this aspect of Maori culture made agreement nearly impossible.

In sum, the Maori people of the Waahi Community found the modelling process instructive, useful, and enjoyable, and the edited videotapes of the process have become part of a participatory planning "kit" about to make its way among other Maori Communities faced with similar problems and prospects. From the standpoint of research, as in the case of the Navajo children described earlier, the set of findings just described was an unanticipated bonus, revealing, as never before, the differences between Maori and Pakeha cognitions of the Maori environment.

Precedents and Consequents: The Past and Future

Environmental design, whether accomplished in the head, on paper, in model form, or on the surface of the planet, is a basic and pervasive human activity. Many of the adult peoples of the world and their children still go about modelling, planning and designing their environments, blindly ignorant of the fact that these are activities to be performed only by trained professionals, or under the supervision of accredited teachers. The results we have obtained, surprising at first, no longer astonish us. For no body of knowledge is more fundamental than environmental knowledge, an understanding of the relationships among people and the places they inhabit.

The work has its precedents, of course, and Doreen Nelson's "City Building Program" is by now one very well-known example. Slightly less well-known

are such other experiments as those of Simon Nicholson, whose school-children used video-taping techniques to obtain answers to the question "how would you have Oxford?" and thereby re-plan the town.

A contemplated extension of the work reported here - one as-yet untapped realm - would combine age and cultural comparisons in a single study. Such a study is in fact planned for a Native American Community, characterized by a tribally and racially mixed population, in early 1980. While our earlier work indicated little difference in level of development, as a function of culture, among pre-school children, similar cross-cultural comparisons have yet to be made for older members of a single milieu.

Conclusion

This has been, in Louis Sullivan's terms, the autobiography of an idea, pursued with love and zest over more than a decade, and over much of the world's surface. Through this work, we have come to know something more about the importance of environmental learning to the process of human development, and of the significance of environmental modelling as both a research tool and as a means for facilitating participation in processes of planning and design.

But there is another aspect to the work, having to do with empowerment. One lacks power to the extent that one is slave to system, be it an educational system, a planning system, or environmental design; one has power to the extent that one can participate in, influence, and change such systems. We have for too long treated the mind of the school-entering child as a tabula raza, devoid of educationally-relevant material, as we have for too long treated non-Western peoples as if they were children. As Native Americans often say when first encouraged to build for themselves: "but....we're not allowed to."

Empowerment is the acquisition of certain tools of expression, tools so simple and possessed of such clarity of expression that the elite cannot turn aside and say, as do architects when confronted with the results of verbal surveys, "we can't relate to that." As with so many things, it proceeds in small steps - and a few small steps have, indeed, been taken.

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